



THE **GLOBE** PROGRAM
Connecting the next generation of scientists

Climate and Land Cover Event 10-16 October 2010



Teachers Guide and Participation Information



The Climate and Land Cover Event Teachers Guide and Participation Information

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Event at a Glance

Explore local land cover, climate and ecosystems; collect and enter digital site photographs and data that will be displayed on a Google Map; use Google Maps and the Google Earth based Geo-Wiki Project to confirm or validate land cover maps used by scientists. Extend this opportunity in the classroom with inquiries and investigations into climate and land cover.

Event Overview

The GLOBE Program's Climate and Land Cover Event is the launch of an ongoing partnership between scientists, citizens and the GLOBE community focused on the relationships between climate and land cover. *GLOBE students and scientists will work together to validate land cover maps through the collection of observation photographs of students' local environments.* As part of GLOBE's continued effort to support student inquiry and cutting edge science, we are pleased to invite you to participate. In joining us, you have the opportunity to inspire student interest in climate and land cover, build collaborations, and help students and scientists better understand the Earth system relationships.

GLOBE has a long tradition of land cover studies, biometry, mapping land cover change, and working with scientists. With the incorporation of 21st century technologies and global communications, we can now apply these skills to the study of climate and land cover. For this pilot event, we are testing several new tools to prepare:

- Digital photo-upload for land cover sites
- Google Map and Google Earth based visualization tools
- Social networking and communication tools for scientists, teachers and classrooms

We encourage you to participate in this event and provide feedback on these new tools. All event communication will take place on the *GLOBE Collaboration website* (details below). Share your comments, suggestions, investigations and ideas at: <http://globecollaboration.ning.com/group/climateandlandcoverevent2010>

Scientists Featured

Scientists Dr. Alexander MacDonald, Steve Albers, and Sara Summers of NOAA's Earth Systems Research Laboratory, are interested in climate and land cover. Their work includes examining land cover maps and using them to better understand how global climate change impacts land cover over time as well as to understand how land cover change impacts climate. The interconnected relationships between climate and land cover, along with the long-term nature of changes in these Earth systems, highlight the importance of using data – including photographs as observations – to support climate related research. Participants of this event will support these scientists and their work by providing photographs of local environments which will be used to better understand land cover and land cover change. If you have questions or comments for the event scientists you can ask them through the GLOBE Collaboration website.

<http://globecollaboration.ning.com/group/climateandlandcoverevent2010>



Context and Background

The type of land cover found in an area is a function of many interrelated variables explored in Earth System Science. Climate is one of the most important variables in determining and understanding natural land cover. Temperature and precipitation, the primary variables in climate, directly influence what plant and animal communities exist in an area. Such relationships can be explored through precipitation and soil moisture, the length of the growing season as reflected in the GLOBE “Green Up” and “Green Down” protocols, or temperature itself as a limiting factor to growth in most species. Scientific records show Earth’s average air temperature has warmed in recent decades and evidence of the relationship between climate and land cover is documented in every region of the world. Understanding the scope of changes to land cover, as well as improving our understanding of land cover change over time, is the core scientific element to this event.

Goals

By participating in this event:

- Students will learn more about the relationship between climate and land cover using field explorations, social networking and communication tools.
- Students will contribute to scientific understand by helping to improve land cover maps and climate models.
- Teachers and students will have the opportunity to build global collaborations based on land cover and climate.

Who can Participate

Everyone around the world with a digital camera and internet access, or a mobile phone with photo capacity can participate in this event! Scientists need all types of land cover, not just rural or natural areas. You do not have to be a GLOBE Teacher or a student in a GLOBE school to participate in this event, however the photos do need to be taken within a GLOBE Country. For a list of participating countries visit: <http://classic.globe.gov/fsl/INTL/table.pl?&lang=en>

Why Participate

Participating schools will contribute to cutting edge science, help improve the initial data sets used in climate modeling, and interact with NOAA scientists through a discussion forum dedicated to this event. Participating students can share their work with others from around the world, build collaborations around ecosystems and climate, and use the data they collect as a base for developing their own research project.

Land Cover Activity

What to Do and How to Do It

Begin this investigation in the classroom by exploring the relationships between the seasons, climate and land cover from a local perspective. This might include discussions about local plant and animal communities, ecosystems, biomes, as well as overarching discussions about weather and climate. Suggested topics include:

- A review of GLOBE Atmosphere and Land Cover data or local weather/climate data
- The relationships between temperature, precipitation, the seasons, and climate
- Temperature and precipitation as limiting factors in both plant and animal communities
- Land cover and its role in the absorption and conversion of solar energy to heat energy
- The relationships between land cover and carbon storage or release
- Anthropogenic land cover change, development, agriculture and local community needs



There are many GLOBE resources that can be helpful in this process:

- The GLOBE Earth System Science Poster and Guide
http://classic.globe.gov/page?earth_system
- The Earth as a System Chapter in the GLOBE Teacher's Guide
<http://classic.globe.gov/tctg/tgchapter.jsp?sectionId=241&lang=EN>
- The Introduction to Land Cover/Biology in the GLOBE Teacher's Guide
http://classic.globe.gov/tctg/land_chapintro.pdf?sectionId=204&lang=EN

Part I—Field Data Collection

Documenting a land cover site with photographs from the field is one part of data collection. Additional information (metadata) is needed so that you and the scientists will have sufficient information about the location and area of the photographs to make sense of the photo when validating the land cover maps.

Step One:

Using local knowledge, maps, or other resources find an area near your school that has a large area (approximately 90 x 90 meters) of consistent or homogeneous land cover. This can be in an urban area (like the school grounds themselves), suburban (the neighborhood surrounding your school), a park/natural area, or even agricultural land. Using a flag or other marker, establish a point for your land cover photos. Try to ensure that you have consistent land cover for 15 meters away from that center point. On the data sheet at the end of this document, record your name and the measurement date.

Step Two:

Using a GPS Unit, a mobile device with GPS capability, or other map-based tool acquire and record your latitude and longitude (in decimal degrees) and your elevation (meters). Visit <http://www.fcc.gov/mb/audio/bickel/DDDMMSS-decimal.html> for more information and a conversion calculator for decimal degrees.)

Step Three:

Standing in the center of your land cover plot, take four digital pictures of your site in each of the cardinal directions (N, S, E, W) by 1) keeping the camera as level as possible and 2) holding a small piece of paper with the cardinal direction written on it in the corner of the camera's view finder. This process will ensure that the pictures are aligned and entered properly into the database.

Step Four:

Using the MODIS Land Cover Classification descriptions below, determine the land cover classification for your study site using the MODIS land cover classification descriptions below and record it on the data sheet. MODIS (Moderate Resolution Imaging Spectroradiometer) is one of the scientific instruments aboard NASA's Terra and Aqua satellites. MODIS scientists have developed this specific land cover classification scheme to aid their analysis of land cover changes over long periods of time.



MODIS Land Cover Classification

ID #	Short Name	Detailed Description
1	Evergreen needleleaf forests	Evergreen needleleaf forests are dominated by trees with a percent of canopy cover greater than 60% and height exceeding 2m. Almost all of its trees remain green all year. Its canopy is never without green foliage.
2	Evergreen broadleaf forests	Evergreen broadleaf forests are dominated by trees with a percent of canopy cover greater than 60% and height exceeding 2m. Almost all of its trees remain green all year. Its canopy is never without green foliage.
3	Deciduous needleleaf forests	Deciduous needleleaf forests are dominated by trees with a percent of canopy cover greater than 60% and height exceeding 2m. It consists of seasonal needleleaf tree communities with an annual cycle of leaf-on and leaf-off periods.
4	Deciduous broadleaf forests	Deciduous broadleaf forests are dominated by trees with a percent of canopy cover greater than 60% and height exceeding 2m. It consists of seasonal broadleaf tree communities with an annual cycle of leaf-on and leaf-off periods.
5	Mixed forests	Lands dominated by trees with a percentage of cover greater than 60% and height exceeding 2m. Consists of tree communities with interspersed mixtures or mosaics of the other four forest types.
6	Closed scrublands	Closed scrublands are lands with woody vegetation less than 2m tall and with shrub canopy greater than 60%. The shrub foliage can be either evergreen or deciduous.
7	Open scrublands	Closed scrublands are lands with woody vegetation less than 2m tall and with shrub canopy between 10-60%. The shrub foliage can be either evergreen or deciduous.
8	Woody Savannas	Woody Savannas are lands with herbaceous and other understory systems, and with forest canopy cover between 30-60%. The forest cover height exceeds 2m.
9	Non-woody Savannas	Non-woody Savannas are lands with herbaceous and other understory systems, and with forest canopy cover between 10-30%. The forest cover height exceeds 2m.
10	Grasslands	Grasslands are lands with herbaceous types of cover. Tree and shrub cover is less than 10%.
11	Permanent wetlands	Permanent wetlands are lands with a permanent mixture of water and herbaceous or woody vegetation that cover extensive areas. The vegetation can be present in salt, brackish, fresh water.
12	Croplands	Croplands are lands covered with temporary crops followed by harvest and a bare soil period (e.g. single and multiple crops systems). Note that perennial woody crops will be classified as the appropriate forest or shrub land cover type.
13	Urban and built-up areas	Urban and built-up areas are covered by buildings and other man-made structures.
14	Cropland/natural vegetation	Cropland/natural vegetation mosaics are lands with a mosaic of croplands, forests, shrublands, and grasslands in which no one component comprises more than 60% of the landscape.
15	Snow and ice	Snow and ice covered areas are lands under snow and/or ice cover throughout the year.
16	Barren and sparsely vegetated	Barren and sparsely vegetated areas are land of exposed soil, sand, rocks, or snow and never has more than 10% vegetated cover during any time of the year.
17	Water	Water bodies are oceans, seas, lakes, reservoirs, and rivers. They can be either fresh or salt water bodies.

Step Five:

Record critical metadata (from the chart below), optional site descriptions, and other information in the space provide on the worksheet.

Urban and Sub-Urban Land Covers	Record and enter the land use (field, garden, playground), building types in the area and number of stories or the approximate height of buildings.
Agricultural Lands	Record and enter the types of crops grown there if known. Indicate if the area is irrigated. If it is pasture land, record "pasture".
In Natural Areas	Record the names of the dominant species in the area if known, as well as the average height of the land cover if it can be determined.



Step Six:

Return to the classroom to enter the data. To ensure security of the image files, there will be a 12-24 hour delay before your data and images appear on the Google Map, so it is critical to have the data entered as soon as possible.

Part II—Data Entry

The GLOBE Program is using the *GLOBE Collaboration Pages* website for this event. This site is also used to test classroom materials and tools for GLOBE's upcoming Student Climate Research Campaign. On the website you will find a "tab" on the top of the dialog box titled "Climate/Land Cover Event". (<http://globecollaboration.ning.com/page/the-globe-climate-and-land>) This is where you will enter data. You will also find a "Climate and Land Cover" discussion group dedicated to the event where much of the social aspects, including collaboration building and question and answer sessions will occur. (<http://globecollaboration.ning.com/group/climateandlandcover>) Please review these resources and provide feedback when appropriate.

Step One:

Copy the image files from the camera or mobile device to your computer. Rename the image files so the name includes both your school name and the cardinal direction the picture represents. An example would be "Newburg Junior High-East.jpg".

Step Two:

Join the *GLOBE Collaboration website* by following this link. Joining the site is free.

<http://globecollaboration.ning.com/group/climateandlandcoverevent2010>

Complete the profile questions as requested. This is a critical for scientist feedback and communications.

Step Three:

On the *GLOBE Collaboration Pages* website, go to the "Climate/Land Cover Event" tab. Place your cursor over the tab and you will see a link titled "Photo Upload." (See image at right.) Select this link to upload the photos directly from your computer. In the dialog box that appears, use the same filename as above, and feel free to add optional descriptive text. Upon completion, a window titled "My Photos" window will automatically open. Keep the image pages open to help with the next step.



Step Four:

With the image window still open, select the original window with the "Climate/Land Cover Event" tab, and click on the link for "Land Cover Data Entry". This will open a page with a form and simple directions for entering your site information. When you reach the steps for photo upload, follow the directions in Step Five.

Step Five:

To enter the photo URL or web address, go back to the "My Photos" page you left open in step three above, and click on your first photo. When it opens, click on the photo again. This will bring up a window with only the photo in it. From your web browser window, select and copy the entire URL or web address, which should look something like:



(<http://api.ning.com:80/files/kXeo3XMXN/GLchFinal150dpi.jpg>). Copy and paste this web address into the “Land Cover Data Entry” form, which is open in another window. Repeat this step to upload all of your photos.

In Part III of this activity you will be sharing your results with scientists who are working to improve computer based models for determining land cover classifications from satellite image data. In completing Part III you can, optionally, provide the URLs of the photos you uploaded above. If you do plan on uploading your photo URLs, then copy the URLs of each photo into a document on your computer so that you can easily retrieve these URLs as you work through Part III.

Step Six:

Complete the rest of the form, including entering your metadata. Submit the form. There will be a 12 to 24 hour delay before your photos appear on the map tool for security purposes.

Part III—Verify Land Cover Classification With Your Data

Step One:

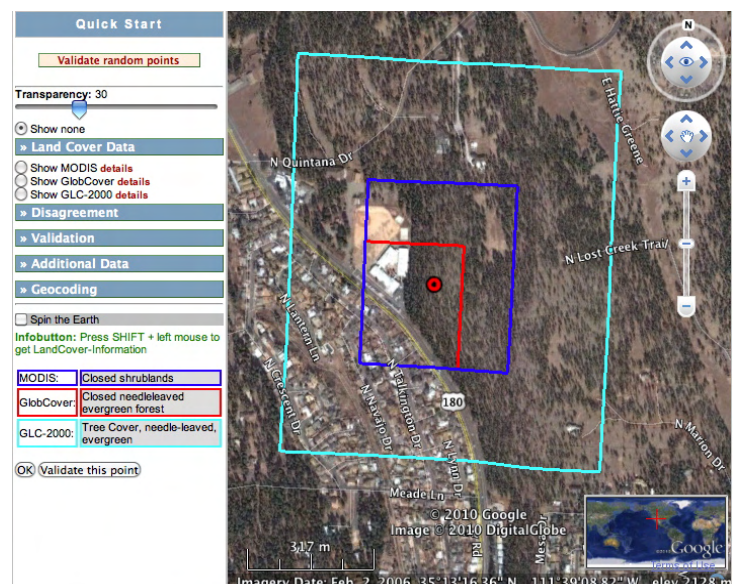
Go to the GLOBE Collaboration website (<http://globecollaboration.ning.com>) and open the “Geo-Wiki Project” tab located beneath the “Climate/Land Cover Event” tab. This will open up to the Geo-Wiki Project home page. Alternatively, select the link on the top of this page to open Geo-Wiki in a new browser window. Navigate to the top right corner of the page and select the “Try as guest” button. This will take you to a Google Earth based web page that is used for remainder of Part III.

(Note: The Google Earth web browser plugin is required to complete this part of the investigation. If you do not have the Google Earth web browser plugin installed you should see a message to download the plugin. Select the “Download the Google Earth Plugin” button to install this plugin. A link to the Google Earth plugin download site is also available at the bottom of this web page.)

Step Two:

Using the Google Earth navigation tools zoom to the location of the land cover site you studied in the previous part of this investigation. Zoom in close enough so that you can clearly identify your study site. Select the precise location of your study site by holding the SHIFT key down while simultaneously left mouse button clicking on your study site location.

A set of red, blue, and aqua colored boxes will appear around the red target spot indicating your study site location. These colored boxes show the boundaries of three different land cover classification schemes—MODIS, GlobCover, and GLC-2000. This activity focuses on the MODIS land cover classification.

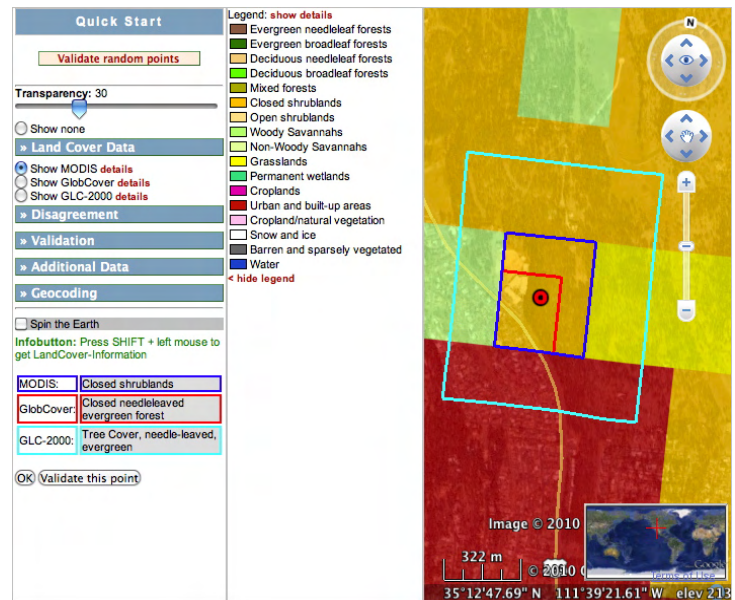




Step Three:

Determine the MODIS land cover classification of your study site, as determined from automated computer analysis MODIS data.

Select the “Show MODIS” radio button located on the left control bar. This will bring up a multi-colored overlay of the land cover classification and a legend. The area within the blue box shows the MODIS land cover classification. The name of the MODIS land cover classification for your location is shown within the blue box on the lower left of the screen.



Step Four:

Submit your data and findings to Geo-Wiki to help improve the computer-based analysis of satellite data.

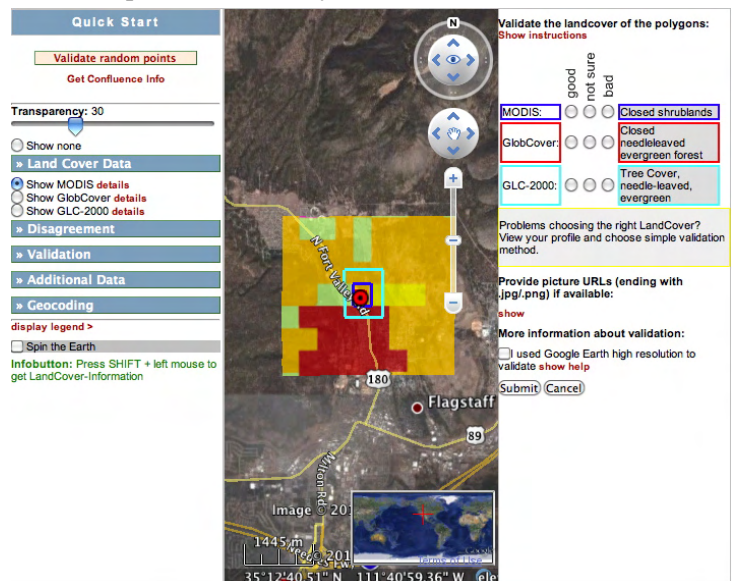
Select the “< hide legend>” text to close the legend.

Click on the “Validate this point” button on the lower left side of the Geo-Wiki web page. The resulting view will look similar to the image at right.

Compare your MODIS land cover classification as determined in Part I of this investigation with the MODIS land cover classification shown on the Geo-Wiki Project page.

Your classification may, or may not, be the same as that displayed on Geo-Wiki. Since you have actual, detailed on-the-ground observations and data, your land cover classification data can be used by scientists to help them improve their methods for computer analysis of satellite data. **Assume that your MODIS land cover classification is correct since it is based upon on-the-ground data.** Based upon your comparison, choose one of the three possible responses below and then select the corresponding MODIS radio button on the upper right side of the Geo-Wiki site.

- Is the MODIS classification shown on Geo-Wiki correct? Select the “good” radio button.
- Are you not sure if the classification shown Geo-Wiki is correct? Select the “not sure” button.
- Is the MODIS classification shown on Geo-Wiki wrong? Select the “bad” button.





If you select the “bad” button, a drop-down menu showing the names of all seventeen MODIS land cover classifications appears. Select the classification that you determined through your field data to be correct.

Optional—Validate the land cover classifications for GlobCover and GLC-2000 by following the same procedure as above.

Optional—Submit the ULRs of your four site photographs that were uploaded in Part II-Step 5 above. Select “**show**” beneath the “Provide picture URLs” text. Paste the URLs of your photographs into the appropriated boxes. Select the date that these photos were taken.

Send your data to scientist by selecting the “Submit” button on the bottom right of the page.

Analysis, Discussion, Research Questions

1. How did your land cover classification differ from that of the computer generated MODIS land cover classification?
2. What are some possible reasons why a computer generated land cover classification analysis would be inaccurate?
3. How do scientists determine land cover from satellite images?
4. Why are there different types of land cover classifications? MUC, MODIS, GlobCover, GLC-2000?

Part IV—Discuss Your Findings With Scientists and Other Students

There is a Climate and Land Cover discussion “group” for this event located at <http://globecollaboration.ning.com/group/climateandlandcover> that has opportunities for you to contribute your extensions and activities, ask questions of both GLOBE staff and NOAA scientists, and to post ideas or requests for collaborations around land cover and climate for other teachers and students. If you have any questions or comments about this resource, please post them to the discussion board or email them to climatecampaign@globe.gov.

Optional Extensions

The optional extension activities below are ways for you to continue your climate and land cover exploration with your students. The first section, Google-Earth Extensions, will require that you download and install software to your school computer(s). Before beginning, consult your system administrator for installation procedures. The second section, Collaboration Extensions, contains a set of activities and ideas to inspire and inform the collaboration building process. The third section, Investigate and Inquire Further, are references to existing GLOBE protocols, learning activities and outside resources. If you have any additional ideas extensions or collaborations, please post them to the discussion board in the GLOBE Collaboration website.



Google-Earth Extensions

Google-Earth is a powerful learning tool that can increase students understanding of the Earth System, 21st Century Skills, as well as global awareness. By downloading the KML files from the Climate/Land Cover Tab, you can access and display all of the data used for this event in Google-Earth. Using the land cover layer, you and your students can explore the relationships between latitude, elevation and land cover type by selecting sample locations from around the world and comparing the land cover types. Reversing this process could also be a valuable way to explore these concepts. In this case, have the students find areas with similar land cover types on multiple continents, or in your region, and explore the variables that influence them. A good example of this would be looking for multiple locations that all have closed forests and relating those locations to the “temperate” belts above and below the tropics.

Another powerful Google-Earth extension uses the Historical Imagery Tool, located in the toolbar on the top of the window with a small “clock” icon. This tool will allow students to view historical images many locations (perhaps of their own area), in some cases dating back several decades. This is a great way to help students understand land cover change over time, and may even help explain some of the errors found in the land cover map. A great example of this application, the 2010 GLOBE Xpedition (<http://globe.gov/events/2010-kilimanjaro-xpedition>) can be found by looking at and comparing the historical images of the glaciers and snow field on Mount Kilimanjaro in eastern Africa. As the Xpedition scientists have observed, and the pictures show, the snowfields and glaciers are receding (shrinking) over time.

Collaboration Extensions

GLOBE’s most important asset is the thousands of teachers, students and scientists located around the world. You are encouraged to create student inquiries and collaborations with other classrooms using the Collaboration Pages and the millions of student-collected scientific data. There are a limitless number of potential collaborations that can be based on your work; below are a few ideas and examples to get you started:

- Students from different locations that have entered the same or similar land cover can compare and contrast the weather and other atmospheric variables to better understand the relationship between weather and climate.
- Students that have entered different land cover types in the same area can explore the relationship between different soils as a potential influence using atmospheric variables as a control for their inquiry.
- Students from multiple locations around the world can collaborate together mapping land cover change using GLOBE protocols and produce a powerful report summarizing their observations and inquiry.
- Students can collect and compare the relationships between [surface temperature](#) and land cover in many areas around the world simultaneously, in an effort to understand how urban areas may impact local weather and climate.

Extensions for Further Investigation and Inquiry

Several GLOBE Protocols can be incorporated into your classroom experience or developed into student inquiries, investigations or reports. These include:

- Incorporating any of the GLOBE Phenology protocols, such as [Green Up](#) and [Green Down](#), to understand how seasonal changes influence land cover and change over time.
- Incorporating the GLOBE [Fire Fuel](#) Protocol help students learn about different types of living and dead organic materials that can become potential fuels for wild fires in their local land cover.
- Conduct the complete [Manual Land Cover Mapping](#) or Computer-aided Land Cover Mapping protocols
- Conduct longer-term investigations of the relationship between climate and land cover or the impacts of climate change on individual species.



THE **GLOBE** PROGRAM
Connecting the next generation of scientists

Valuable Links and Resources

GLOBE Land Cover Sample Site Protocol

http://classic.globe.gov/tctg/land_prot_samplesite.pdf?sectionId=209&lang=EN

The GLOBE Land Cover Investigation Worksheet (pdf)

http://classic.globe.gov/tctg/lc_ds_samplesite.pdf?sectionId=469&lang=EN

GLOBE Sample Site Selection and Set-Up (pdf)

http://classic.globe.gov/tctg/land_prot_siteselect.pdf?sectionId=207&lang=EN

GLOBE Manual Land Cover Mapping Protocol (pdf)

http://classic.globe.gov/tctg/land_prot_manualmap.pdf?sectionId=211&lang=EN

GLOBE Land Cover/Biology Chapter in the GLOBE Teacher's Guide

<http://classic.globe.gov/tctg/tgchapter.jsp?sectionId=201&lang=EN>



Frequently Asked Questions

Do I have to be a certified GLOBE Teacher or from a GLOBE School to participate?

No, for this event you do not have to be a registered GLOBE Teacher or School, but you do have to be in a GLOBE Country to participate. List of GLOBE countries (<http://classic.globe.gov/fsl/INTL/table.pl>).

Do I have to be in a rural or natural area to participate?

No, in fact we are encouraging GLOBE school in all areas to participate, particularly schools in suburban, urban and agricultural areas.

Do I have to have a large homogeneous area to participate?

No. To enter the data into the GLOBE database, you have to have to follow the protocols, and that means an area of at least 90x90 meters, but entering the data into the GLOBE database is not required and will not limit your ability to participate in the photo upload, land cover analysis activities, or collaborations.

I've already taken photos of my GLOBE land cover site and submitted them to GLOBE. Can I still participate?

Yes! Your participation is very important. Because you have submitted photos in the past, you have established base-line data for your site. By taking photographs again of the same location and entering them into the database you are helping to contribute to an understanding of how land cover changes over time.

I entered my data, but I cannot find it on the Google Map.

First, the time needed for security check may not have been met (12-24 hours depending on your location) or second, the latitude and longitude data you entered had an error in it. If the pictures you took do not display correctly, then the issue was likely an error in the copy-paste process for the image URL or web addresses.

How do I access the *GLOBE Collaboration Pages* website?

To access all of the learning materials and web-based tools associated with Climate and Land Cover event you need to join the GLOBE Collaboration Network. There is no cost to join. Simply navigate your browser to <http://globecollaboration.ning.com/?xgi=bhcBTOW> where you will be asked to fill out a brief registration form. After completing the registration form navigate to the Climate and Land Cover Event ~ 2010 Group page (<http://globecollaboration.ning.com/group/climateandlandcoverevent2010>) or the Climate/Land Cover Event tab (<http://globecollaboration.ning.com/page/the-globe-climate-and-land>).

Where can I find more information about or download a free copy of Google-Earth?

Information, tutorials and downloading instructions can be found at: <http://www.google.com/earth/index.html>

My school is not a GLOBE school, but would like to become one. How do I do this?

Navigate your web browser to <http://globe.gov/about/join> to learn more about participating in the GLOBE Program.

I would like my students to participate in the GLOBE Student Climate Research Campaign (SCRC). How can I get more information?

Navigate your web browser to <http://globe.gov/scrc> and select "join the SCRC". Additional information will be provided to you via email. You do not need to be a GLOBE School to participate in the SCRC.



Land Cover Data Sheet

School/Organization Name _____

Mailing Address _____

Country _____

GLOBE School ID (If not a GLOBE School, leave blank) _____

Measurement Date (Year/Month/Day) _____

Latitude (Decimal Degrees) _____

Longitude (Decimal Degrees) _____

Elevation (Meters) _____

Photo #1 Direction: ☐ North ☐ East ☐ South ☐ West ☐ Other _____

Photo #1 Notes _____

Photo #2 Direction: ☐ North ☐ East ☐ South ☐ West ☐ Other _____

Photo #2 Notes _____

Photo #3 Direction: ☐ North ☐ East ☐ South ☐ West ☐ Other _____

Photo #3 Notes _____

Photo #4 Direction: ☐ North ☐ East ☐ South ☐ West ☐ Other _____

Photo #4 Notes _____

MODIS Classification ID Number _____

MODIS Classification Short Name _____

Other Comments or Metadata